

*New Nebulæ discovered photographically with the Crossley Reflector of the Lick Observatory.* By James E. Keeler, D.Sc.

In a recent number of the *Monthly Notices* (vol. lix. p. 537) I printed a list of seven small nebulae found on plates which had been exposed to the nebula *Messier 51* with the Crossley reflector. At that time I considered this a rather remarkable number of nebulae to be found on a plate covering only about one square degree, but more recent experience has shown that as many new nebulae may generally be found on photographs taken with the Crossley reflector, and sometimes a much larger number. Thus, on a plate exposed for four hours, on November 6, to the nebula H V. 19 *Andromedæ*, there are thirty-one new nebulae and nebulous stars; on a photograph of H I. 53 *Pegasi*, twenty; and there are nearly as many on several other plates. Besides these new nebulae, the existence of which has been verified by independent photographs, the plates contain a considerable number of objects which are probably nebulae so small that the resolving power of the telescope is insufficient to define them in their real form and to bring out their true character. They appear as star-discs which are less dense than true star-discs having the same diameter.

With exposures of four hours the Crossley photographs show stars and nebulae far beyond the range of any visual telescope, though there are hundreds, if not thousands, of unrecorded nebulae within reach of our 36-inch refractor. On the assumption that there are three new nebulae in each square degree (a number which is much below the average for the photographs I have already taken), the number of new nebulae in the whole sky would be about 120,000. Doubtless there are large regions where few, if any, new nebulae are to be found; still, I am disposed to regard the above estimate as below the truth.

It is a remarkable and highly significant fact that most of the nebulae photographed with the Crossley reflector seem to be spirals. In various cases known nebulae have already been shown to have a spiral form by other observers. The Crossley photographs have shown that many other known nebulae have the same structure; while in the case of a large proportion of the new nebulae I have mentioned, a spiral form is either directly recognisable, or is rendered highly probable by the fact that the nebulae have the same appearance as well-known spirals when photographed with a small instrument. We may perhaps regard the spiral form as that which is normally assumed by a compact isolated nebulous mass, and the exceptions (of which there are many) to somewhat unusual conditions—possibly, in part, to the absence of any definite moment of rotation for the aggregate of the particles constituting the nebula.

*Lick Observatory, University of California:*  
1899 November 15.

*Nebulae discovered at the Chamberlin Observatory, University Park, Colorado. By Herbert A. Howe.**(Communicated by the Secretaries.)*

The following nebulae have been incidentally noted during the past few months, while making measures of catalogued nebulae with the 20-inch refractor. The positions given depend upon micrometric measures, and are for 1900.0. In the "Descriptions" and "Notes" numbers enclosed in brackets refer to Dreyer's Index Catalogue; other numbers are those of the N.G.C. :—

No.	Date. 1898.	R.A. h m s	Dec. ° ' "	Descriptions.
1	Dec. 16	0 50 50	-10 31'6	vF, S, near 309.
2	Jan. 6	2 29 16	-11 28'7	eS, vF, R, prob. nebs. *. Near 977 and 981.
3	Mar. 14	9 22 9	-11 40'5	F, vS, 10 <sup>m</sup> * p 7 <sup>s</sup> , 0'8 n.
4	Apr. 10	10 31 20	-12 12'3	eF, eS, possibly a *.
5	May 11	12 43 46	-13 51'1	vF, vmE 210°, 2' long.
6	May 10	12 45 2	-13 50'1	eF, vS.
7	May 10	12 45 9	-13 46'6	eF, vS.
8	May 10	12 45 16	-13 52'9	eF, vS.
9	May 10	12 45 23	-13 56'9 ±	eeF, vS, possibly a 14 <sup>m</sup> *.
10	May 11	12 46 4	-14 1'8	F, vS, R.
11	May 10	14 14 12	-4 1'6	vF, S, mE 200°. Near (997).
12	Sept. 7	18 36 40	+39 56'1	eS, eF. Near 6685 and 6686.
13	Sept. 17	21 34 6	-22 51'4	vS, eF. Near 7103 and 7104.
14	Oct. 11	23 34 19	-22 58'0	vF, vS, R, 6'5 n of Swift 234.
15	Nov. 16	23 41 10	-28 33'6	vF, vmE 200°, 20'' long.

*Notes.*

No. 1 precedes 309 51<sup>s</sup>, 1'5 south.

No. 3 follows 2881 about a minute (of time).

No. 4 is near 3295 and 3296, which precede the places given by Leavenworth by 2<sup>m</sup> 40<sup>s</sup>. Leavenworth gave the same right ascension for 3295, 3296, and 3297. On 1899 April 10 I measured the places of 3295 and 3296. I could only suspect 3297. The object which I have supposed to be new follows the others 3<sup>m</sup> 30<sup>s</sup>.

Nos. 5-10, together with No. 15 of my former list, published in *Monthly Notices*, vol. lviii. No. 9, are in the vicinity of 4724 and 4727. I believe 4726 and 4740 to be identical at 12<sup>h</sup> 46<sup>m</sup> 18<sup>s</sup>, -13° 40'6.

No. 11 precedes (997) about 30<sup>s</sup>. (998), which its discoverer pronounces "eeF, v diffic.," I did not see. In its position, or very near it, is a double star of mags. 13.5-13.5, distance 30'', and angle 160°.

No. 12 precedes 6685 less than 2<sup>s</sup>, 2'7 north. Between them lies a star of mag. 11.5.

No. 13 is in the same field with 7103, 7104 (1393), and No. 17 of my list in *Monthly Notices*, vol. lviii. No. 9. These five objects have all been seen in one night. Between my two novæ and 7103 one or two may exist, having

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